

Alignment between Data Warehouse Design and Business Strategy :

A Systematic Review

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Abstract :

Data warehouse has become a very important tool for supporting the corporate executives in making important decisions in a highly competitive business environment. Data warehouse enables the top management to acquire and analyze integrated data extracted globally across the enterprise. Many organizations are sitting on vast amount of data already accumulated in their operational database. The huge data repository with potential strategic business information can be analysed comprehensively only through the usage of data warehouse system. The main objective of this paper is to systematically review the development and adoption of data warehouse design in business environment and the different models to assess the alignment between information technology strategy and business strategy.

Keywords : data warehouse design; strategic alignment; business strategy

INTRODUCTION

The globalization process during the last few decades has profound impact on the business environment domestically and internationally. On one hand, such process has strengthened the business linkages across nations, which enables companies to access larger market domain globally. On the other hand, it has also brought about intensified competition to the companies. To thrive in this growing competitive environment, businesses have been urged to shorten their product lifecycles, improve their productivity and operational efficiency, add value to their customer satisfaction, and swiftly identify and penetrate into new markets. These responses imply that companies are in needs of quick and accurate information for fast, effective, and efficient decision making [1]. It is perceived that the adoption of data warehouse is one of the most effective approaches to enable companies to fulfill these needs [2].

The implementation of data warehouse in business is expected to enable the company to effectively use data for strategic decision making, and hence to grant a competitive advantage [3]. Such advantage could be capitalized through increasing sale revenues [4], adding value for customers' satisfaction [5], and identifying and penetrating into new market [6].

The perceived benefits of the data warehouse have stimulated a wide practice of such information technology. The proportion of the companies implemented this technology has increased from 10% to 80% in 1994, and the market value has increased from \$ 2 billion in 1995 to \$ 8 billion in 1998 [7]. In addition, nearly 90% of the Fortune 2000 companies across the global have implemented some sort of data warehousing projects [8]. In addition, the implementation of such technology can be found across various industries, namely banking, financial services, health care, retail, telecommunications and so on. Such popularity of the data warehouse in industries has been primarily driven by the belief that such technology will improve the financial performance of the business [9].

Regrettably, the development of data warehouse projects in the past has shown high failure rates [10]. For instance, [11] reported that the rate of project failures run as high as 60%. Similarly, [8] found that nearly 85% of all data warehousing projects have failed to achieve their intended initiatives, and 40% of the total projects have even failed to pass the planning stage. Some researchers have attributed such high failure rates to the significant amount of staff, hardware, software, time and funds needed to develop and implement the project [3], the poor quality of data [10], the lack of executive sponsorship [12]. Others believe that it is the irrelevance of the data warehouse objectives to the overall business strategy ([13]; [14]) and the improper design of the data warehouse [15].

The match or fit between information technology strategy and business strategy in a business has been commonly referred as strategic alignment or alignment. In the field of Information System (IS), strategic alignment is believed to be critical for the success of an organization. Firms which have failed to do so will suffer failures in their intended IS development initiatives. In fact, past researches have shown that companies that have successfully capitalized strategic alignment have benefited from improved competitive advantage [16] and hence enhanced business performance ([17]; [18]). Though the importance of strategic alignment has been well received in the field of IS, alignment researches pertaining to the subject of data warehouse is still meager. In particular, little has been known on the effect of alignment between data warehouse design and business strategy on the performance of the business. Thus, this study intends to systematically review the development and adoption of data warehouse design in business environment and the different models to assess the alignment between information technology strategy and business strategy.

LITERATURE REVIEW

A. Data Warehouse

In Inmon's seminal work "Building the data warehouse", the father of data warehousing has described data warehouse as "... a subject-oriented, integrated, non-volatile, time-variant collection of data in support of management's decision making process." [19, p. 29]. He further explains that the data gathered, stored and merged in the warehouse should not only contain information on the areas of interest, but also information on the time dimension of the data. Another prominent guru of data warehouse, [20] provided a simpler version of definition in his seminal work "The Data Warehouse Toolkit". Kimball referred data warehouse as the "copy of transaction data specifically structured for query and analysis" [20, p. 310]. In other words, it is a strategic tool to collect, store, and integrate business information in order to facilitate an organization to make faster and better decisions.

Data warehouse is not a new concept, rather the origin of which can be traced back to as early as 1854 when it was used to fight the outbreak of cholera in London. Since the beginning 1990s, the development of data warehouse in an organization has become business driven. During this period, the adoption of the data warehouse in the business has been primarily motivated by its benefit of allowing the use of data in innovative ways [6]. The implementation of data warehouse has been thriving since mid-1990s [2]. The development of data warehouse projects in these companies is believed to be lured by its advantages in supporting effective and better decision making [3], identifying and penetrating into new market [6], and adding value to customer satisfaction [5].

Data warehouse offers solutions for the business organizations to integrate corporate-wide data into a centralized repository [2], and hence enables end-users to access the timely, accurate, and consistent data stored in warehouse based on their varying interests to make effective decisions [21]. Since the data is periodically replicated from diverse sources and is integrated to discern patterns of behavior, data warehouse supports users to understand the historical performance of the business and to predict or manage future business outcomes [22].

Despite numerous potential advantages provided by the implementation of data warehouse, the development and adoption of such project in a company involves a complex process and high failure rate. In fact, the implementation of data warehouse requires massive amount of investment in term of both time and capital [2]. For instance, it estimated that the average cost of building a standard data warehouse is approximately \$5 million [23]. In addition, it has also found that such expensive and time consuming project also yields high risk of failure, which ranges from 50% [3] to 85% [8].

Past researches on the causes of the data warehouse failures have not reached consensus. In general, these causes can be classified into two broad categories: the complexity of the development and implementation process, and the irrelevance of the data warehouse to the business. As for the former, it is believed that the development and implementation of the project is both time and capital consuming [2]. Besides the complexity and sophistication of the software and hardware comprised in the system, the unrealistic expectation of the inexperienced end-users on the ability of the data warehouse has also be considered as the major culprit for the failure [24]. As for the latter, the irrelevance of the data warehouse can be attributed to the lack of communication between IT and business departments of the organization [25], improper architecture or design of the data warehouse [26], the poor quality of data to fulfill the needs of the end-users [14], and the mismatching between objectives of data warehouse and that of the business [13].

In order to successfully capitalize the potential benefits of the data warehouse, some studies have outlined critical factors that influence the success of the project [27]. These critical success factors have been listed in the table as follow:

- Fit between corporate strategy and business objectives
- Complete buy-in to the project
- Management expectations
- Incremental development of data warehouse
- Build-in adaptability
- Joint management between IT and business professionals

- Develop a business/supplier relationship
- Loaded data have to be cleaned and understood by the organization
- Training requirements are needed
- Be politically aware

In addition, [27] advocated that the alignment between data warehouse, corporate strategy and business objectives is the most prominent principle for the success of the project. Similarly, [7] also believed that the best practice of data warehousing project is to align the design of the warehouse with the business structure of the company. In an article named “Planning for a Data Warehouse” [28] upheld that the best overall objective of implementing the data warehouse is to align the organizational goals explicitly with the strategic business plan. In addition, it has also found that, thanks to the alignment between data warehouse and corporate strategy, the implementation of data warehouse successfully transferred First American Cooperation into an innovative leader in the American financial service industry [4].

B. Strategic Alignment

The match or fit between information technology strategy and business strategy in a business has been commonly referred to as strategic alignment in the field of Information System. Strategic alignment has been commonly perceived as one of the most critical factors for the success of both Information Technology and organization [29]. In fact, organizations that have successfully aligned their business and IT strategies have found to yield better performance than those that have not [30]. The successful capitalization of strategic alignment in a business has also found to be conducive for the company to establish a competitive advantage over the other rivals [29]; [16]. Such advantage ranges from revenue and profitability enhancement ([31];[18]), efficiency /cost reduction [32], ability to identify new market and react flexibly to capture the new opportunities [31], and so on. On the other hand, companies failed to achieve strategic alignment cannot take full advantage of IT [32]. In addition, the lack of IT-business alignment has also been blamed for the waste of the IT resources, and failures of IT projects [33].

Although the importance of strategic alignment has been well received among both IS academicians and practitioners, it has no universally accepted definition [34]. The ambiguity on the meaning of strategy alignment can be evidenced from both the varying versions of the definition and the large array of interchangeable terms used in the past researches. For instance, [35] defined strategic alignment as the degree of fit or integration across four domains of an organization, namely business strategy, IT strategy, business infrastructure, and IT infrastructure. To [36], it denoted the degree to which the mission, objective and plan of the Information Technology support that of the business organization. In addition, [37] referred to it as the harmonious relationship between the business and IT functions, particularly in the adoption of strategies in these two functions. On the other hand, it has also found that the term “fit”, “integration”, “harmony”, “linkage”, “match”, “fusion” and so on, have been used interchangeably with alignment among in the past researches [38].

The importance and potential benefits of the strategic alignment have contributed a flood of researches dedicated to design conceptual models and frameworks to explain and hence measure strategic alignment in the business. Such development process can be traced back to 1980s, when the role of Information Technology shifted from a mere

business support to a strategic weapon [39]. Among all these models, the strategic alignment model (SAM) proposed by [35] has been commonly perceived as the mostly accepted models among the alignment community. In addition, it has also been considered the SAM model as the mother model for the other strategic alignment frameworks ([30]; [34]).

SAM model by [35] comprises of four domains of strategic choice: business strategy, information technology strategy, organizational infrastructure and process, and information technology infrastructure and process (see Figure 1). In addition, this model takes into account bivariate and cross-domain alignment, as well as internal and external alignment. The bivariate alignment refers to the fit between any two domains, either vertically or horizontally. The former is commonly referred as strategic fit, which denotes the linkage between strategy and organizational infrastructure and process or between IT strategies and IS infrastructure and process. In addition, the fit between IT and business strategies is perceived as external alignment, whereas the linkage of infrastructure and process between the business and IT is considered as internal alignment. As for the horizontal alignment, it implies the linkage between business strategy and IT strategy or between organizational infrastructure and process and IS infrastructure and process. On the other hand, cross-domain alignment refers to the fit between any three domains. This aspect of alignment is also known as the strategic alignment perspectives.

A number of measurement approaches have been designed in the past empirical researches to assess the alignment. In a broad sense, these empirical approaches can be classified into two categories, including fit model, and survey-based approach. The concept of “fit” can be traced back to its origin in [40], which has defined fit in six perspective: moderation, mediation, matching, co-variation, profit deviation, and gestalts. Since past empirical studies have advocated that the applications of different perspectives of fit yield inconsistent on alignment ([41]; [42]), it is critical for the selection of appropriate fit models [30]. In fact, it is suggested that the application of each perspective in the measurement of alignment should take into account three key issues: the functional form of fit, the number of variables used in the model, and the inclusion of the criteria variable [32]. For instance, [43] claimed that “mediation”, “moderation”, and “profit deviation” can be used for researches that involve a criteria item as the dependent variable, while the other three conceptualization of fit can only be applied to researches that are criterion free.

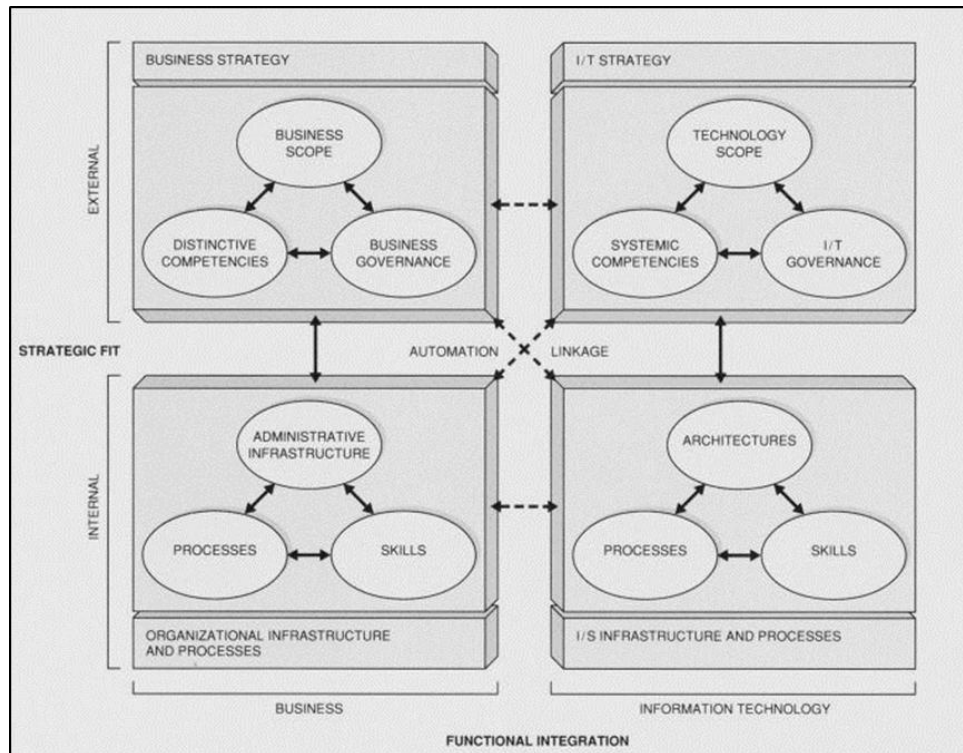


Fig. 1. [35] SAM model

In another study, [44] developed a Strategic Orientation of IS (STROIS) instrument with the reference to the Strategic Orientation of Business Enterprises (STROBE) instrument developed by [45]. In particular, STROBE instrument was developed to examine realized strategy of a firm through dimensions that are common for all business. These dimensions include aggressiveness, analysis, defensiveness, futurity, pro-activeness, and riskiness. In reference to [45] detailed explanations on each of these six dimensions of the strategic orientation are listed as follows:

- **Aggressiveness:** It refers to the mechanism adopted by the business to allocate resources in order to capture better market positions in comparisons with the competitors.
- **Analysis:** it refers to the trait of the firm to find best solution for the business to overcome challenges faced by in the business, or to achieve targeted objectives.
- **Defensiveness:** It refers to the cost reduction an efficiency seeking methods for firms to preserve their products, markets, and technologies.
- **Futurity:** it refers to the temporal considering in the relative emphasis of effectiveness versus efficiency.
- **Pro-activeness:** It reflects the proactive behavior of firms in searching for market opportunities, and participating in emerging industries.
- **Riskiness:** It captures the extent of riskiness reflected in various resource allocation decisions as well as the choice of produces and markets.

In response to [45]'s STROBE instrument to assess business strategy of firms, [44] developed STROIS instrument to describe the realized information systems strategy of a business. Similar to STROBE instrument, the STROIS instrument of [44] shares the same six dimensions of strategic orientation. Since the STROIS was developed to cope with STROBE to determine the level of strategic fit between IS and business strategies, [44]'s STROIS instrument investigated the extent to which firms' IS enable them to be aggressive, analytical, future oriented, proactive, risk-averse, and defensive [46]. By applying [40]'s moderation to measure strategic fit, [44] shown that firms with higher value for STROBE*STROIS perform better than those of lower value for STROBE*STROIS.

As for the survey approach, questionnaire items related to the nature of business organization, their department, and information technology are included in the survey. The Likert-scale ratings of these questions will provide helpful information on the overall level of alignment in the business [32]. It is believed that the more detailed survey questions provide greater reliability and validity on the assessment of alignment [30]. For instance, [47] proposed a survey approach to measure alignment between IT plan and business plan. This questionnaire approach comprises a total of twelve measurement items, with six items for each aspects of the alignment. In addition, a 6-point Likert scale was used to rank these questionnaire items. In another study, [48] designed a questionnaire to investigate the alignment between IT strategy, IT structure, business strategy, and business structure among Canadian SMEs.

Although the importance of the alignment between IT and business for the success of the organization has been well acknowledged in the field of IS, the alignment researches in the field of data warehouse are still scant. Despite the fact that alignment is a critical factors for an organization to effectively capture the potential benefits of data warehouse investments ([4];[7];[27]), there is little insight on how data warehouses should be developed and implemented to align with business strategies [1].

CONCLUSION

In today's highly competitive business environment, corporate executives must have access to all vital information across the organization at hand in order to make correct planning and right business decision making. Companies need to make fast, effective, and efficient decision making. It is perceived that the adoption of data warehouse is one of the most effective approaches to enable companies to fulfill these needs [2]. Data warehouse is not a new concept and its origin can be traced back to as early as 1854 when it was used to fight the outbreak of cholera in London. However, the development of data warehouse projects in the past has shown high failure rates. Some researchers attributed such high failure rates to the significant amount of resources (e.g. staff, hardware, software, time and funds) needed to develop and implement the project, the poor quality of data, the lack of executive sponsorship, the mismatch between data warehouse objectives with the overall business strategy and the improper design of the data warehouse.

In order to successfully capitalize the potential benefits of data warehouse, the critical factors that contribute to the success of the project, among others include: match between corporate strategy and business objectives, complete buy-in to the project, management expectations, incremental development of data warehouse, build-in adaptability, joint management between IT and business professionals, develop a business/supplier relationship, loaded data have to be cleaned and understood by the organization, training requirements are needed and political awareness.

Strategic alignment has been commonly perceived as one of the most critical factors for the success of both Information Technology and organization. Organizations which have successfully aligned their business and IT strategies have found to yield better performance and establish a competitive advantage over their rivals. On the other hand, organizations which failed to achieve strategic alignment could not take full advantage of IT and the lack of IT-business alignment has also been blamed for the waste of the IT resources and failures of IT projects.

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